BIOLOGIA PLANTARUM 38 (4): 601-603, 1996

BRIEF COMMUNICATION

Effect of gibberellic acid and nitrogen on carbonic anhydrase activity and mustard biomass

N.A. KHAN, H.R. ANSARI and M. MOBIN

Department of Botany, Aligarh Muslim University, Aligarh-202 002, India

Abstract

In mustard (*Brassica juncea* L.) addition of 20 mM nitrogen (in the form of $NaNO_3$) inhibited after 50 d the activities of carbonic anhydrase and nitrate reductase and net photosynthetic rate. However, when nitrogen was applied in association with the foliar spray of gibberellic acid, the inhibition was reversed and the above parameters and also leaf area index and dry mass were enhanced.

Additional key words: *Brassica juncea*, dry mass, leaf area index, net photosynthetic rate, nitrate reductase.

We found earlier that carbonic anhydrase (CA) activity is regulated by gibberellic acid (GA_3) application (Khan 1996). The goal of the present study was to find out the effect of different concentrations of nitrogen applied with or without GA_3 on carbonic anhydrase (CA) and nitrate reductase (NR) activities, net photosynthetic rate (P_N), leaf area index (LAI) and dry mass of mustard.

Mustard (*Brassica juncea* L. Czern & Coss.) cv. T-59 plants (three per pot) were grown in an eathern pots filled with acid washed sand in a glasshouse under natural conditions. At alternate days in the morning each pot was supplied with 200 cm^3 (from day 30 with 500 cm^3) of Hoagland nutrient solution with various nitrogen concentrations. In addition to this, 250 cm^3 of de-ionised water was added to every pot in the evening as the plants matured. Nitrogen was given in the form of $NaNO_3$ and sodium ion was balanced by supplying NaCl. There was three nitrogen treatments: 5 mM (N_5 - suboptimal N), 10 mM (N_{10} - sufficient N) and 20 mM (N_{20} - supraoptimal N) with and without spraying with 50 μM GA_3 at 30 d after sowing, every treatment in eight replications. CA, NR, P_N, LAI and dry mass were recorded 50 d after sowing.

Received 25 November 1995, *accepted* 20 January 1996.

The CA activity in leaves was estimated by the Dwivedi and Randhava (1974) method (for details see Khan 1994), the NR activity was determined according to Jaworski (1971). P_N in the leaf samples that were later selected for the estimation of CA, was measured by the *LI 6200* Portable Photosynthesis System (*LICOR*, Lincoln, USA). LAI was calculated using graph paper outlining the leaves. The plants were oven dried and total dry mass was determined. The results were analysed for variance according to Gomez and Gomez (1984).

CA and NR activities and P_N were found higher at N_{10} than at N_5. However, N_{20} inhibited these activities (Table 1). When GA_3 was applied along with different concentrations of nitrogen, the CA activity increased from suboptimal N_5 to the supraoptimal N_{20}, and therefore available concentration of inorganic carbon was higher for ribulose-1,5-bisphosphate carboxylase. This resulted in an increase in P_N. NR activity, LAI and dry mass showed similar patterns (Table 1).

Table 1. Effect of GA_3 (50 μM) and nitrogen (5, 10 and 20 mM $NaNO_3$) on carbonic anhydrase (CA) activity [mol(CO_2) kg^{-1}(f.m.) s^{-1}], nitrate reductase (NR) activity [μmol(NO_2) kg^{-1}(f.m.) s^{-1}], net photosynthetic rate (P_N) [μmol(CO_2) m^{-2} s^{-1}], leaf area index (LAI) and dry mass [g $plant^{-1}$] of mustard.

Treatment	CA activity	NR activity	P_N	LAI	Dry mass
N_5	1.97	0.29	10.06	2.44	1.62
N_{10}	2.14	0.37	14.92	3.69	2.98
N_{20}	1.67	0.36	13.68	4.26	3.11
GA_3 N_5	2.15	0.32	12.46	2.86	1.88
GA_3 N_{10}	2.21	0.46	15.92	4.24	3.46
GA_3 N_{20}	2.31	0.55	17.56	4.88	6.24
CD at 5 %	0.02	0.01	1.22	0.46	0.36

Enhancement of NR activity by GA_3 or GA_3 + cytokinin in tobacco leaves was found by Roth-Bejerano and Lips (1970). Our work confirmed the results of Everson (1970) that inhibition by supraoptimal nitrate supply can be reversed if HCO_3 concentration is raised. GA_3 at various concentrations of nitrogen increased LAI through enhancing cell number and cell size. The increase in LAI provided larger total photosynthetic area and the enhancement in P_N resulted in increased accumulation of dry mass. The correlation coefficients between LAI and dry mass and P_N and dry mass were 0.981** and 0.988**, respectively, that showed a dependence of dry mass on both LAI and P_N.

References

Dwivedi, R.S., Randhava, N.S.: Evaluation of a rapid test for the hidden hunger of zinc in plants. - Plant Soil **40**: 445-451, 1974.

Everson, R.G.: Carbonic anhydrase and CO_2 fixation in isolated chloroplasts. - Phytochemistry **9**: 25-32, 1970.

Gomez, K.A., Gomez, A.A.: Statistical Procedure for Agricultural Research. - Wiley InterScience Publ., New York 1984.

Joworski, E.G.: Nitrate reductase assay in intact plant tissues. - Biochem. biophys. Res. Commun. **43**: 1274-1279, 1971.

Khan, N.A.: Variation in carbonic anhydrase activity and its relationship with photosynthesis and dry mass of mustard. - Photosynthetica **30**: 317-320, 1994.

Khan, N.A.: Effect of gibberellic acid on carbonic anhydrase, photosynthesis, growth and yield of mustard. - Biol. Plant. **38**: 145-147, 1995.

Roth-Bejerano, N., Lips, S.H.: Hormonal regulation of nitrate reductase activity in leaves. - New Phytol. **69**: 165-169, 1970.